



# Assessing the decadal impact of China's sloping land conversion program on household income under enrollment and earning differentiation



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## ABSTRACT

This study hypothesizes that the income levels of households are affected by their different areas enrolled in the Sloping Land Conversion Program, the local economic condition, and the statuses of their previous earnings. We test these relationships by running quantile regressions with data collected from 182 households in the Loess Plateau region covering the period of 1998–2011. We find that the more cropland was retired, the more subsidy was received, and the more labor was set free from farming, which, in turn, led to a larger decrease in farming income but a much larger gain in off-farm income. Further, the area enrolled had a more positive effect during 1998–2004 than that during 2006–2011 on all households; and the positive effect was significant only on those households of the 0.25th and 0.50th income quantiles later. Also, the proportion of off-farm labor to total labor, the off-farm work time, and the local GDP per capita had a larger income effect in the later sub-period, especially for households in the 0.75th and 0.90th income quantiles. These results carry major implications in terms of how to reduce poverty and increase income in ecologically fragile regions in and outside of China and how to assess the effect and effectiveness of any ecological conservation program.

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## 1. Introduction

In 1999, China launched the Sloping Land Conversion Program (SLCP)—the largest ecological restoration, or payments for ecosystem services (PES), initiative in the developing world (Liu et al., 2008; Bennett, 2008). The SLCP aims to reverse the country's environmental deterioration by retiring and converting degraded cropland while improving farmers' livelihoods, especially those of the rural poor (State Forestry Administration, or SFA, 2003). The program provides financial incentives to farmers who establish forest or grass cover on retired cropland in order to “supply” ecosystem services, such as reduction of water runoff and soil erosion, and prevention of flooding (Yin, 2009).

Given the substantial funding of over 300 billion yuan thus far (SFA, 2013)<sup>1</sup> and the broad attention that the PES program has garnered, there have been extensive assessments of the extent to which it has met its objectives (e.g., Liu et al., 2008; Yin, 2009; Li et al., 2011). While studies generally agree that the income impacts of the program vary in terms of the levels of cropland enrollment and the statuses of family earnings (e.g., Liu and Zhang, 2006; Yao et al., 2010; Groom and Palmer, 2012), it remains rare to look explicitly into the income

impacts in light of these differences. In particular, it is still unclear whether or not the poor farmers have benefitted more than proportionately from participating in the program. The goal of this paper is to address these issues by evaluating the income effects of the SLCP in a more disaggregate and nuanced manner.

Among the program practitioners and analysts, a consensus is that household income growth is an important indicator of the impact and sustainability of the SLCP (Liu et al., 2008; Uchida et al., 2007). Implementing the SLCP has both direct and indirect impacts on household income (Yin et al., 2014; Lin and Yao, 2014; Liu et al., 2010). The direct effect is reflected mainly in the government subsidies relative to the lost income from grain and livestock production. The initial duration of the subsidy was set at eight years for the period of 2001–2008, with a grain compensation of 2250 kg/ha in the Yangtze River Basin and 1500 kg/ha in the Yellow River Basin (Xu et al., 2004a). In addition, an annual cash outlay of 300 yuan/ha was universally adopted for tending and protecting the planted trees and other established vegetation covers. Due to the dwindling public grain stocks, however, since 2004 the grain compensation has been replaced with a cash payment at a constant rate of 1.4 yuan/kg (Xu et al., 2004a). To continue the ecosystem recovery and to improve the program's cost effectiveness, in 2007 the central government decided to extend the subsidy for another eight years but to reduce the cash compensation for lost grain yields to half of the previous levels (Yin and Yin, 2010).

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<sup>1</sup> \$1 = 6.15 yuan in March 2014.

The SLCP's indirect impact on household income is captured mostly in the earnings from adjusting the production and employment structures induced by the SLCP (Lin and Yao, 2014; Yin, 2009). Indeed, households participating in the SLCP have experienced substantial transformations in these respects. While cropland area has decreased sharply, farming on remaining cropland has become more intensive and animal husbandry switched from open grazing to pen-raising (Yao et al., 2010; Liu et al., 2013). At the same time, the SLCP has enabled the rural labor force freed from farming to seek and obtain off-farm jobs in and outside of their locales and the non-farming income generated has become a very large component of the household total income (Yin et al., 2014; Lin and Yao, 2014; Xu et al., 2006).

One question of common interest is to what extent the substantial household income gain has been driven by implementing the SLCP and whether this effect has to do with the heterogeneity of cropland retirement intensity and the status of household earnings (Zhao et al., 2015). In fact, a large body of literature has focused on answering this question. For example, Uchida et al. (2005) find that the average household net income increased considerably for the SLCP participants in Ningxia and Guizhou. Similarly, Liu and Zhang (2006) detect a positive impact of converting farmland to forests on household income in the proximity of Beijing and Tianjin. The evidence generated by Yao et al. (2010), and Li et al. (2011) also confirms a positive income effect, a larger part of which has indeed come indirectly from the structural adjustment and labor transfer into off-farm sectors.

More notably, Groom and Palmer (2012), using quantile regressions and pooled data from Ningxia and Guizhou, report that the SLCP's impact on household income was significantly positive at the lower quantiles of the income distribution, compared to their non-participating counterparts. The use of quantile regressions to assess the potentially differentiated income impacts is a novel step, but the data these authors used cover a short period of time (only 1998 and 2004). So, their study was unable to examine the more recent situation, particularly after 2008 when the subsidy was cut back substantially. Moreover, they did not consider the possible effects of such factors as on- and off-farm work times, on household income.

In contrast, Xu et al. (2004a) show that the growth rates in average income varied across regions over the period of 1999–2003, but the overall impact of the SLCP on participants' income was insignificant. Uchida et al. (2007) identify only a moderate success of the SLCP in achieving poverty alleviation; further, they fail to obtain evidence to support the claim that participating households have shifted more of their work time into off-farm wage-earning or self-employing activities. Wang and Maclaren (2012) even go so far as to assert that 58% of the families participating in the program considered themselves worse off after getting enrolled; also, farmers in the Wolong Nature Reserve intended to reconvert 22.6% of the land enrolled in the SLCP to farming after the end of the subsidies, and the land to be reconverted in northern Shaanxi could amount to 37.2% of the enrolled total.

Different, and often contradictory, conclusions have been drawn on household poverty reduction and income growth in previous studies. Why is this? First, most of the studies have focused on the income impact of the entire sample, without looking into the potentially differentiated impacts corresponding to the variable levels of SLCP enrollment (Zhao et al., 2015). Second, the datasets used in many studies have short-time coverages, either before 2006 (Xu et al., 2004a; Uchida et al., 2005; Groom and Palmer, 2012; Liu and Zhang, 2006), or only after 2006 (Yao et al., 2010; Wang and Maclaren, 2012), which may be inadequate to capture changes in the SLCP's income effects over time. Moreover, the program's effect and effectiveness are ultimately predicated on the internal and external local conditions under which it has been executed (Yin et al., 2010). Therefore, it is crucial to identify these conditions and incorporate them into an impact assessment.

In this article, we attempt to overcome the limitations of the previous studies of the SLCP's impact on poverty alleviation and income growth. We will do so, first, by using household survey data that cover

a long period (1998–2011) and at the same time adopting alternative estimation strategies to reflect the subsidy regime shift. Second, we will classify the sample households into multiple groups according to their land areas enrolled and earnings to capture the potentially differentiated income effects of participating in the program, with particular attention given to those poor families. It is expected that based on appropriate quantile regressions (Meyer and Sullivan, 2013; Zhang et al., 2005), these steps will generate a rich set of empirical results and thus make a timely contribution to better understanding of the program's effect and effectiveness. Further, we hope that our work will shed light on how to properly assess similar ecological restoration efforts in other parts of the world.

The remainder of this paper is organized as follows: the next two sections describe the study site and survey data, following which the empirical model and estimated results are then presented, and closing remarks are made in the final section.

## 2. Study site

Our data for evaluating the income change induced by implementing the SLCP came from multiple rounds of household surveys conducted in the county of Wuqi in northern Shaanxi province (Fig. 1). Before discussing our surveys and presenting our data, it is worthwhile to provide a brief description of the county and the structural change of farmer's income there since the end of the last century.

Situated in the northwest of Yan'an municipality, Wuqi had a total population of 127,369 in 2011. While the official demographic statistics show that the county's rural residents remained close to 110,000, more than a half of the rural labor had been involved in off-farm and/or off-village employment and business activities (Wuqi Statistics Bureau, 2012). Before 1998, Wuqi had a cultivated land base of 123,700 ha, and a majority of the rural households also raised goats, whose population peaked to 280,000 in the late 1990s. As a consequence of extensive farming and open grazing, the county's land and vegetation were heavily degraded, making the problems of water runoff, soil erosion, and flash flooding extremely severe.

In response, the county began retiring croplands on steep slopes and converting them to forest and/or grass covers in 1998. Taking advantage of the national initiative, the county's set-aside of marginal cropland expanded tremendously in 1999—two years ahead of most other places across the country. Quickly, cropland was cut back to only 10,730 ha, and open grazing was completely banned (Wuqi SLCP Office, 2012). To facilitate the ecological and economic transformation, the county government has invested heavily in such activities as improving the quality of the remaining farmland, introducing new breeds of crops and animals, and promoting best land-use practices, complementing the national ecological restoration initiative. As such, Wuqi was later selected by the provincial and central governments as a model county in pioneering cropland retirement and restoration (Yao et al., 2010). It was based on these developments that our research team decided to monitor the program implementation and its impacts there since 2005.

Table 1 summarizes farmer's per-capita incomes from different sources from 1998 to 2011.<sup>2</sup> It can be seen that total income witnessed a remarkable increase over the period—from 1432 yuan in 1998 to 1968 yuan in 2004 and 3794 yuan in 2011. Farming income decreased from 947 yuan in 1998 to 482 yuan in 2006 and then rebounded to 695 yuan in 2011. Similarly, animal husbandry income decreased from 396 yuan in 1998 to 110 yuan in 2004 and slightly recovered to 180 yuan in 2011. Starting at 481 yuan in 1999, income from the SLCP subsidies rose to 883 yuan in 2004 and declined to 643 yuan on average in 2011. Meanwhile, the government began to subsidize farming in 2004 as well (at a level of only 16 yuan per capita), which rose to 213 yuan

<sup>2</sup> The use of per-capita based figures helps avoid the confounding effect of household size variation over time.

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